In the Claims

Cancel claims 31, 39, 43-48 and 50.

Amend claims 23-30, 32-38 and 40-42 where indicated.

23. (Currently Amended) A method of making a magnetic read head wherein the read head has a read region that has first and second sides that extend substantially perpendicular to the ABS, first and second end regions that are adjacent the first and second sides respectively and the read region and first and second end regions being adjacent the ABS, comprising:

forming a first shield layer;

forming an insulation layer on the first shield layer;

forming an antiferromagnetic oxide film on the insulation film;

forming a spin valve sensor with a non-magnetic layer directly on a first gap layer, the first gap layer comprising a bi-layer of said insulation film and said antiferromagnetic oxide film;

forming a mask on the spin valve sensor with first and second openings ~~at first and second lead layer sites~~ wherein the first and second openings define first and second side edges of ~~a~~ the spin valve sensor to be located in the read region;

milling away spin valve sensor material in the first and second openings to expose the antiferromagnetic oxide film;

forming first and second lead layers on the antiferromagnetic oxide film in the first and second openings;

removing the mask;

forming a second gap layer on the spin valve sensor and the first and second lead layers; and

forming a second shield layer on the second gap layer.

24. (Original) A method as claimed in claim 23 wherein the first and second lead layers have a ferromagnetic film formed directly on the antiferromagnetic oxide film in the first and second end regions respectively.

25. (Original) A method as claimed in claim 24 wherein the spin valve sensor is formed in the presence of a magnetic field that is directed perpendicular to the ABS and the first and second lead layers are formed in the presence of a magnetic field that is directed parallel to the ABS.

26. (Currently Amended) A method of making a magnetic read head wherein the read head has a read region that has first and second sides that extend substantially perpendicular to the ABS, first and second end regions that are adjacent the first and second sides respectively and the read region and first and second end regions being adjacent the ABS, comprising:

forming a first shield layer;

forming an insulation film on the first shield layer;

forming an antiferromagnetic oxide film on the insulation film;

forming a spin valve sensor on a first read gap layer which comprises bi-layer of said insulation film and said antiferromagnetic oxide film;

said forming of the spin valve sensor including:

forming a non-magnetic seed layer directly on the antiferromagnetic oxide film;

forming a ferromagnetic free layer on the non-magnetic seed layer;

forming a electrically conductive non-magnetic spacer layer on the free layer;

forming a ferromagnetic pinned layer on the electrically conductive non-magnetic spacer layer;

forming an antiferromagnetic metallic layer of Ni-Mn on the ferromagnetic pinned layer;

forming a cap layer on the antiferromagnetic metallic layer;

annealing the ferromagnetic pinned layer and the antiferromagnetic metallic layer of Ni-Mn at 240°-280° for 2-10 hours in ~~a~~ the presence of a magnetic field that is directed transverse to the ABS;

forming a mask with first and second openings at the first and second end regions wherein the first and second openings define said first and second sides of the read region;

milling away the spin valve sensor within each of the first and second openings to expose the antiferromagnetic oxide film;

forming first and second lead layers on the antiferromagnetic oxide film in the first and second openings respectively; and

removing the ~~mark;~~ mask;

milling away the cap layer and a portion of the antiferromagnetic metallic layer of the spin valve sensor; ~~and a portion of the cap layer of the first and second lead layers;~~

forming a second read gap layer on the antiferromagnetic metallic layer and on the first and second lead layers; and

forming a second shield layer on the second read gap layer.

~~27~~. (Original) ~~A~~ The method as claimed in claim ~~26~~ 4 wherein the antiferromagnetic oxide film is NiO.

~~28~~. (Original) ~~A~~ The method as claimed in claim ~~27~~ 5 wherein the forming each of the first and second lead layers comprises:

forming a soft ferromagnetic film directly on the antiferromagnetic oxide film portion in a respective end region;

forming a non-magnetic adhesion film on a respective soft ferromagnetic film in a respective end region;

forming an electrically conductive non-magnetic film on a respective non-magnetic adhesion film in a respective end region; and

forming a non-magnetic cap layer on a respective electrically conductive non-magnetic film in a respective end region.

~~29~~. (Currently Amended) ~~A~~ The method as claimed in claim ~~28~~ 6 wherein the first and second lead layers are formed in the presence of a magnetic field that is directed parallel to the ABS.

30. (Currently Amended) A method of making a magnetic read head that has an air bearing surface (ABS), a read region that has first and second sides that extend substantially perpendicular to the ABS, first and second end regions that are adjacent the first and second sides respectively and the read region and first and second end regions being adjacent the ABS, comprising:

forming a read sensor in the read region with first and second side edges that define said first and second sides of the read region as follows:

forming a ferromagnetic free layer and a ferromagnetic pinned layer;

forming an electrically conductive non-magnetic spacer layer between the free and pinned layers;

forming an antiferromagnetic metallic layer that exchange couples to the pinned layer; and

forming a cap layer, on the antiferromagnetic metallic layer;

forming first and second lead layers in the first and second end regions with each lead layer having a first side edge wherein the first side edge of the first lead layer is adjacent the first side edge of the read sensor and the first side edge of the second lead layer is adjacent the second side edge of the read sensor;

forming first and second gap layers with each gap layer located in each of the read region and the first and second end regions;

~~forming the read sensor and the first and second gap layers between the first and second shield layers;~~

forming first and second shield layers with the read sensor and the first and second gap layers located therebetween;

forming an antiferromagnetic oxide film ~~between an insulation film and the first lead layer in the first end region, between the insulation film and the read sensor in the read region and between the insulation film and the second lead layer in the second end region with~~ interfacing the first and second lead layers; ~~being exchange coupling to the antiferromagnetic oxide film and magnetostatically coupling to the read sensor; and~~

forming each of the first and second lead layers with a ferromagnetic film so that the ferromagnetic film of each of the first and second lead layers exchange couples to the antiferromagnetic oxide film in the first and second end regions respectively and magnetostatically couples to the read sensor; and

wherein the forming of the read sensor ~~locating~~ locates the free layer between the antiferromagnetic oxide film and the pinned layer.

31. (Cancel)

32. (Currently Amended) ~~A~~ The method as claimed in claim ~~31~~ 30 wherein the making of each lead layer includes:

forming non-magnetic adhesion and cap films;

forming an electrically conductive non-magnetic film between the non-magnetic adhesion and cap films; and

in each of the first and second lead layers, forming the ferromagnetic film between the non-magnetic adhesion film and the antiferromagnetic oxide film in the first and second end regions, respectively.

33. (Original) ~~A~~ The method as claimed in claim 32 wherein the antiferromagnetic metallic layer is selected from the group consisting of Ir-Mn, Ni-Mn, Rh-Mn, Pt-Mn, Pd-Pt-Mn and Cr-Pt-Mn.

34. (Original) ~~A~~ The method as claimed in claim 32 wherein the antiferromagnetic oxide film is selected from the group consisting of NiO and α-Fe_2O_3.

35. (Original) ~~A~~ The method as claimed in claim 34 wherein the antiferromagnetic metallic layer is selected from the group consisting of Ir-Mn, Ni-Mn, Rh-Mn, Pt-Mn, Pd-Pt-Mn and Cr-Pt-Mn.

36. (Currently Amended) ~~A~~ The method as claimed in claim 32 wherein ~~the non-magnetic seed layer is Ta,~~ the free film is Ni-Fe, the spacer layer is Cu, the pinned layer is Co and the antiferromagnetic metallic layer is Ni-Mn.

37. (Original) A method as claimed in claim 36 wherein the antiferromagnetic oxide film is selected from the group NiO and α-Fe_2O_3.

38. (Original) A method as claimed in claim 32 wherein the antiferromagnetic oxide film is NiO and the ferromagnetic film of each of the first and second lead layers is Ni-Fe.

39. (Cancel)

40. (Original) A method as claimed in claim 39 wherein the antiferromagnetic metallic layer is Ni-Mn.

41. (Original) A method as claimed in claim 40 wherein a thickness of the metallic antiferromagnetic layer is 15 - 25 nm.

42. (Original) A method as claimed in claim 41 wherein the antiferromagnetic oxide film is NiO and the ferromagnetic film of each of the first and second lead layers is Ni-Fe.

43. (Cancel)

44. (Cancel)

45. (Cancel)

46. (Cancel)

47. (Cancel)

48. (Cancel)

50. (Cancel)

Add new claims 51-63.

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51. (New) A method of making a magnetic read head that has a head surface for facing a magnetic medium, comprising the steps of:

forming a first shield layer;

forming a first read gap layer comprising the steps of:

forming an insulation film on the first shield layer; and

forming an antiferromagnetic oxide film on the insulation film;

forming a spin valve sensor material layer directly on the first read gap layer;

forming a mask on the spin valve sensor material layer with first and second openings;

milling away portions of the spin valve sensor material layer in the first and second openings to expose the antiferromagnetic oxide film and form a spin valve sensor with first and second side edges;

forming first and second lead layers on the antiferromagnetic oxide film in the first and second openings and adjacent said first and second side edges respectively;

removing the mask;

forming a second read gap layer on the spin valve sensor and the first and second lead layers; and

forming a second shield layer on the second read gap layer.

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52. (New) A method as claimed in claim 51 wherein each of the first and second lead layers includes a ferromagnetic film.

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53. (New) A method as claimed in claim 52 wherein the spin valve sensor is formed in the presence of a magnetic field that is directed perpendicular to the head surface and the first and second lead layers are formed in the presence of a magnetic field that is directed parallel to the head surface.

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54. (New) A method of making a magnetic read head that has a head surface for facing a magnetic medium, comprising the steps of:

forming a ferromagnetic first shield layer;

forming a first read gap layer on the first shield layer comprising the steps of:

forming an insulation film on the first shield layer; and

forming an antiferromagnetic oxide film on the insulation film;

forming a read sensor on the first read gap layer with first and second side edges that intersect the head surface comprising the steps of:

forming a ferromagnetic free layer and a ferromagnetic pinned layer;

forming an electrically conductive non-magnetic spacer layer between the free and pinned layers;

forming an antiferromagnetic metallic layer that exchange couples to the pinned layer; and

forming a cap layer on the antiferromagnetic metallic layer;

forming first and second lead layers interfacing the first and second side edges respectively of the sensor;

forming a second read gap layer on the sensor and the first and second lead layers;

forming a ferromagnetic second shield layer on the second read gap layer; and

forming each of the first and second lead layers with a ferromagnetic film so that the ferromagnetic film of each of the first and second lead layers exchange couples to the antiferromagnetic oxide film and magnetostatically couples to the read sensor.

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55. (New) A method as claimed in claim 54 wherein the making of each lead layer includes:

forming non-magnetic adhesion and cap films;

forming an electrically conductive non-magnetic film between the non-magnetic adhesion and cap films; and

in each of the first and second lead layers, forming the ferromagnetic film between the non-magnetic adhesion film and the antiferromagnetic oxide film.

56. (New) A method as claimed in claim 55 wherein the antiferromagnetic metallic layer is selected from the group Ir-Mn, Ni-Mn, Rh-Mn, Pt-Mn, Pd-Pt-Mn and Cr-Pt-Mn.

57. (New) A method as claimed in claim 55 wherein the antiferromagnetic oxide film is selected from the group NiO and α-Fe_2O_3.

58. (New) A method as claimed in claim 57 wherein the antiferromagnetic metallic layer is selected from the group Ir-Mn, Ni-Mn, Rh-Mn, Pt-Mn, Pd-Pt-Mn and Cr-Pt-Mn.

59. (New) A method as claimed in claim 55 wherein the free film is Ni-Fe, the spacer layer is Cu, the pinned layer is Co and the antiferromagnetic metallic layer is Ni-Mn.

60. (New) A method as claimed in claim 55 wherein the antiferromagnetic oxide film is NiO and the ferromagnetic film of each of the first and second lead layers is Ni-Fe.

61. (New) A method as claimed in claim 60 wherein the antiferromagnetic metallic layer is Ni-Mn.

62. (New) A method as claimed in claim 61 wherein a thickness of the metallic antiferromagnetic layer is 15 - 25 nm.

63. (New) A method as claimed in claim 62 wherein the antiferromagnetic oxide film is NiO and the ferromagnetic film of each of the first and second lead layers is Ni-Fe.